MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015 / 2016

PCF0145 – CELL AND FUNCTION

(Foundation in Life Sciences students only)

17 October 2015
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 7 pages only excluding the cover page.
2. Answer any **FIVE** out of **SIX** questions.
3. Please write all your answers in the answer booklet provided.
4. Distribution of marks for each section / question is given.

STRUCTURED QUESTIONS [50 MARKS]

Instruction: Answer any **FIVE** out of **SIX** questions.

Question 1 (10 marks)

a. Differentiate between *microevolution* and *macroevolution*. (2 marks)

b. The three types of *natural selection* are termed *directional selection*, *disruptive selection* and *stabilizing selection*. Using a population of rabbits with varying shades of fur colour (**Figure 1**) as a specific example, explain how these three types of selection differ from one another. Provide 2 points for each selection. In a habitat which is completely filled with white snow, which of these selections will likely predominate for a population of these rabbits after a long period of time? (4 marks)

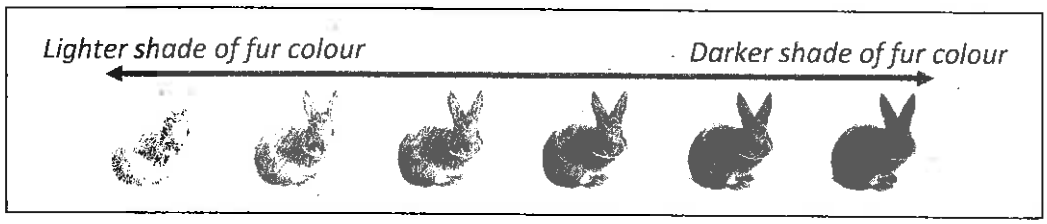

Figure 1

c. What do you understand by the term 'denaturation' in the context of protein function? Provide two instances in which this process might take place. (2 marks)

d. **Figure 2** is a diagram of a plant cell with 4 labeled *organelles*. Provide the name and main function for each of the *organelles* labeled in **Figure 2**. (2 marks)

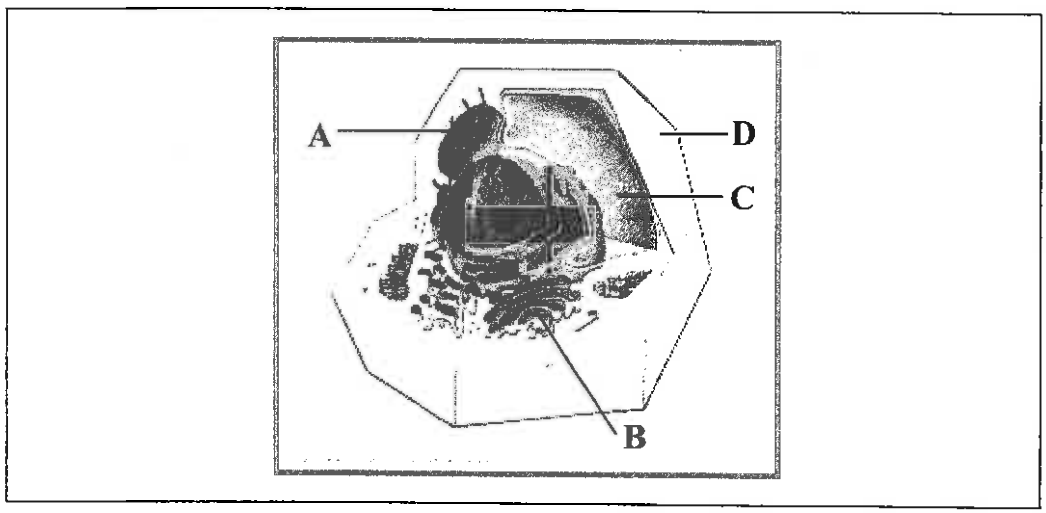

Figure 2

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Question 2 (10 marks)

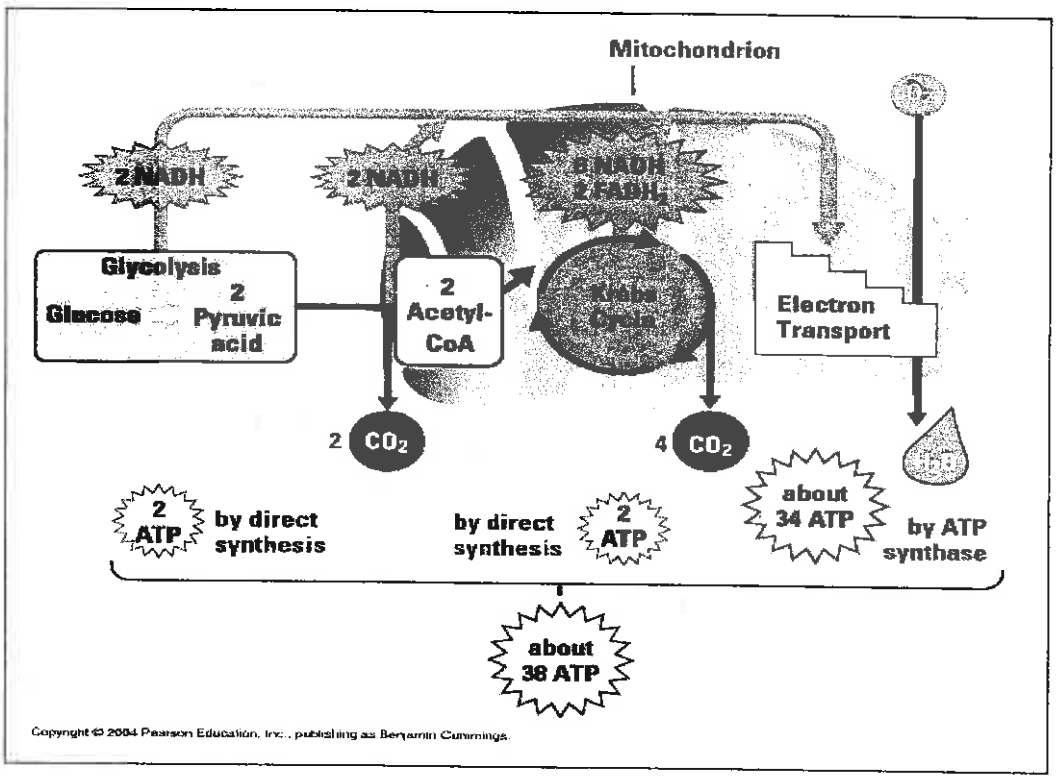

Figure 3

a. **Figure 3** is a diagram representing the main stages of *cellular respiration*. Based on this diagram, answer the following questions:

(i) For each molecule of glucose that undergoes the process of *cellular respiration*, how many molecules of carbon dioxide (CO_2) are released? (½ mark)

(ii) If **10** molecules of **Acetyl-CoA** enter the *Krebs cycle*, how many molecules of NADH and $FADH_2$ will be produced, respectively from the *Krebs cycle*? (½ mark)

(iii) If **5** molecules of **glucose** are provided to the *Glycolysis* stage, how many molecules of ATP will be produced in the *Electron Transport* stage? (½ mark)

(iv) What **is** the function of NADH? (½ mark)

(v) What is an *ATP synthase* and what is its function? (1 mark)
How does it produce more ATPs than direct synthesis? Explain briefly. (1 mark)

b. Using a labelled diagram, accurately **illustrate** (draw/sketch) the link between *light reactions* and the *Calvin cycle*. Include the following molecules in your diagram: H_2O, O_2, CO_2, $C_6H_{12}O_6$, ATP, NADPH. (3 marks)

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c. **Figure 4** details the processes that take place during the *Calvin cycle* with each major process numbered as ❶, ❷, ❸ and ❹. Based on **Figure 4**, answer the following.

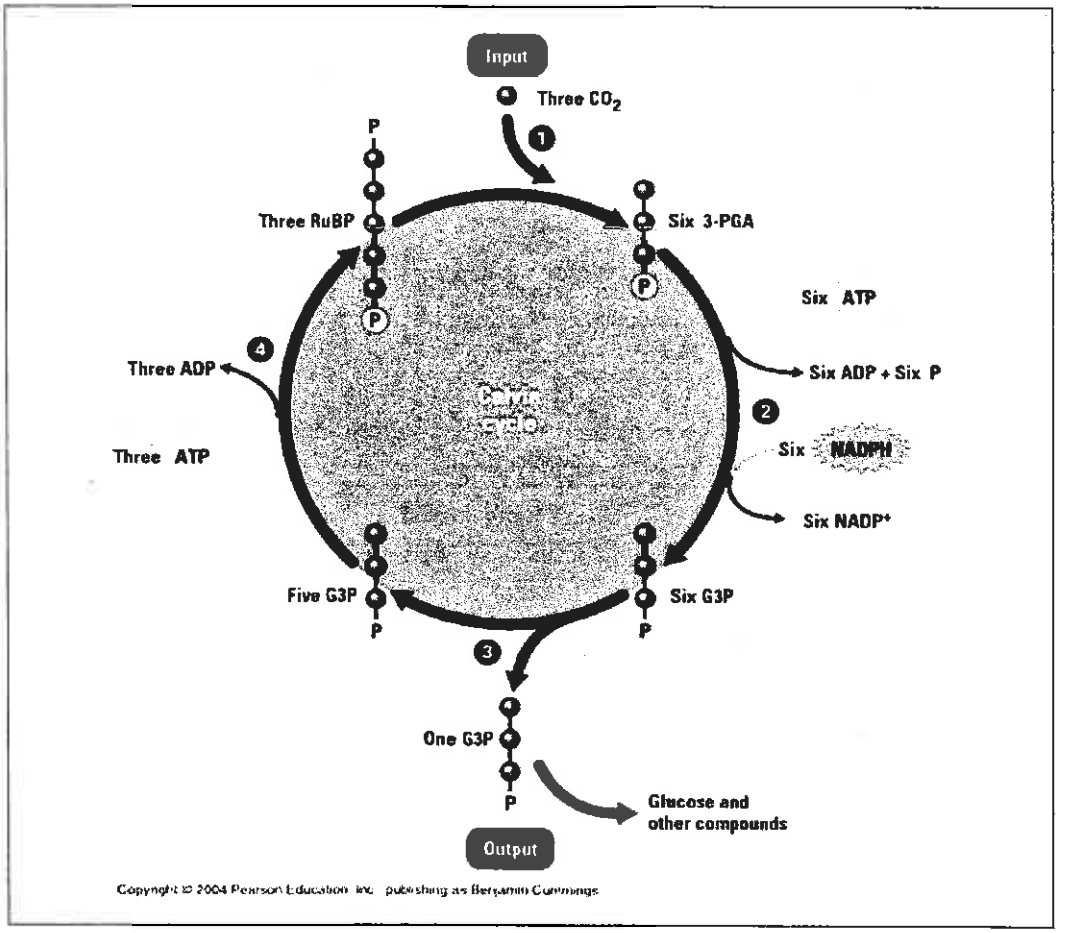

Figure 4

(i) With reference to **Figure 4**, choose the major process which is known as the "*reduction step*". Provide a short explanation for your answer. (2 marks)

(ii) What is the function of G3P? (½ mark)

(iii) Where in the chloroplast does the *Calvin cycle* take place? (½ mark)

Continued...

Question 3 (10 marks)

a. There are two containers, one contains *inhaled gas* while the other contains *exhaled gas* from the same living breathing specimen. Based on the "content of gases" within the two containers, how would you know which of the two containers contains *inhaled gas* while the other contains *exhaled gas*? (2 marks)

b. *Electrocardiography* (ECG) produces waves known as **P**, **Q**, **R**, **S** and **T**. Briefly describe the processes in the heart that correspond to (i) **P**, (ii) **Q-R-S** and (iii) **T**, and (iv) explain the medical purpose of *electrocardiography*. (2 marks)

c. Explain the difference between the following terms:

(i) *Systole* and *Diastole* (1 mark)

(ii) *Pulmonary Semilunar Valve* and *Aortic Semilunar Valve* (1 mark)

d. Four widely known lymphatic organs in the human body are *red bone marrow*, *thymus gland*, *lymph nodes* and *spleen* as represented in **Figure 5**.

(i) What happens if an individual's *thymus gland* fails to function? (1 mark)

(ii) What happens if an individual's *spleen* fails to function? (1 mark)

(iii) What is the main function of the *red bone marrow*? Elaborate briefly. (1 mark)

(iv) What is the purpose of *lymph nodes*? Elaborate briefly. (1 mark)

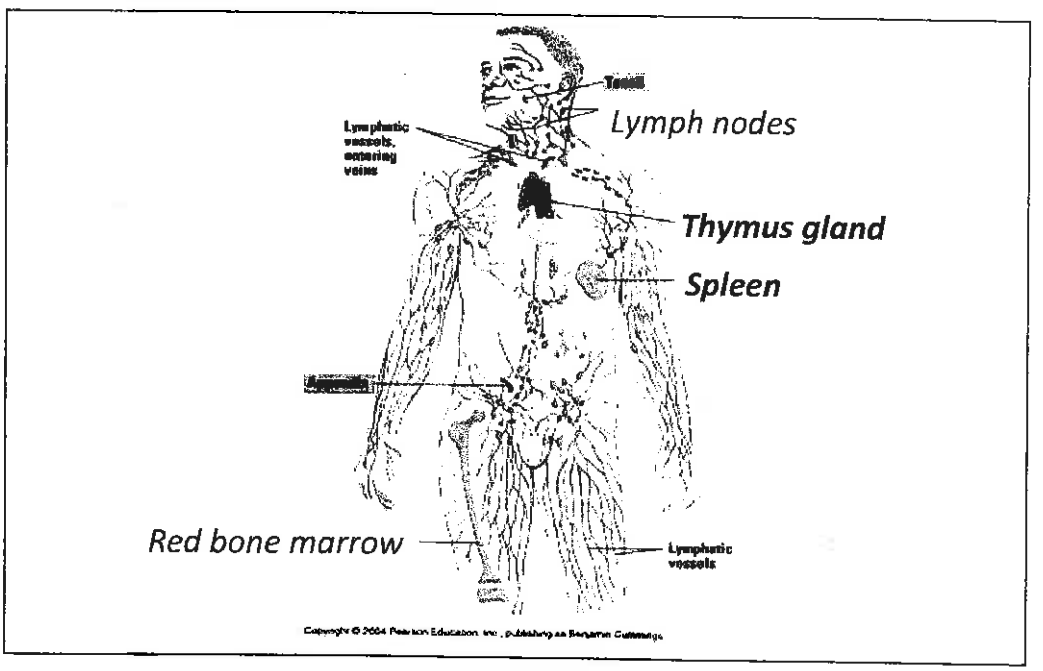

Figure 5

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Question 4 (10 marks)

a. A *nephron* is a single functional unit of the kidney. A *nephron* consists of a nephron tube and its associated blood vessels. The function of a *nephron* is to extract a tiny amount of filtrate from the blood and refine the filtrate into a much smaller quantity of urine. Based on this information, answer the following.

(i) Sketch a simple diagram that depicts a single *nephron*. Label your diagram with each of these 8 terms: *Bowman's Capsule*, *Glomerulus*, *Collecting Duct*, *Loop of Henle*, *Distal Convoluted Tubule*, *Proximal Convoluted Tubule*, *Efferent Arteriole* and *Afferent Arteriole*. (2 marks)

(ii) Water reabsorption occurs in many parts of the *nephron* in the human kidney. What happens if this process fails to take place? (1 mark)

(iii) Selective reabsorption of free amino acids as well as glucose through "active transport" takes place in the *proximal tubule*. Provide two vital information regarding the term "active transport". (2 × ½ mark)

(iv) What happens in the *distal tubule* that helps to maintain blood pH? (2 × ½ mark)

b. There are three types of neurons, namely the *sensory neuron*, the *interneuron* and the *motor neuron*. Based on this information, answer the following.

(i) Based on appearance, how does one differentiate between a *sensory neuron* and a *motor neuron*? (1 mark)

(ii) Based on appearance, how does one differentiate between a *motor neuron* and an *interneuron*? (1 mark)

(iii) Why are the axons in the *motor neurons* covered with insulating layers called *myelin sheaths*? (1 mark)

c. The liver is a large lobed organ in the abdomen of vertebrates that plays an essential role in many metabolic processes. Answer the following questions.

(i) If the liver fails to function in a human being as a result of disease, what would be the possible main cause of death in such an individual? (1 mark)

(ii) What is the role of the liver in maintaining *blood glucose level*? Elaborate. (1 mark)

Continued...

Question 5 (10 marks)

a. The diagram below (**Figure 6**) shows the voltmeter readings (in mV) of the membrane potential at various stages comprising "Stage I", "Stage II", "Stage III" and "Stage IV". For each of the stages shown in **Figure 6**, describe the ionic basis of *action potential* using the movements of Na^+ and K^+ ions and/or the opening or closing of the Na^+ and K^+ gates/channels as part of your description. (4 marks)

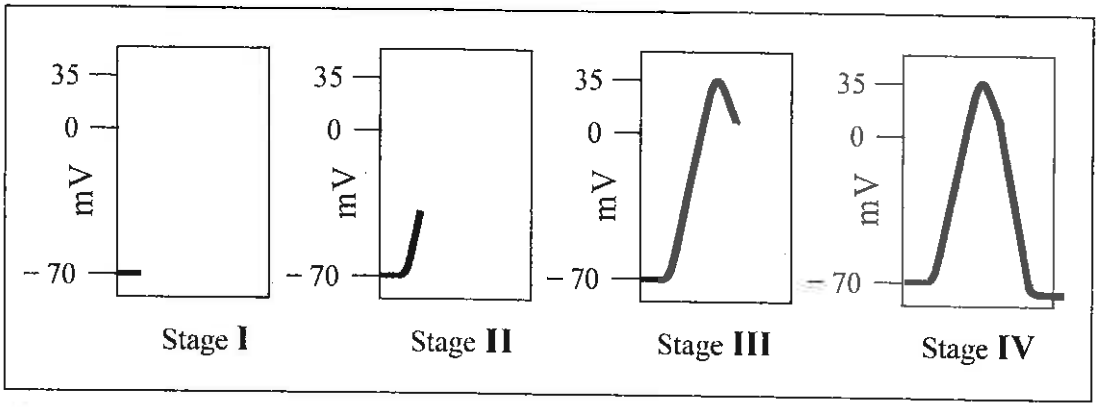

Figure 6

b. The *autonomic nervous system* is divided into the *sympathetic nervous system* and the *parasympathetic nervous system*. Distinguish between these two nervous systems and for each nervous system, provide an example of its function. (2 marks)

c. Describe the process of *homeostasis* of blood calcium level by using the *calcitonin hormone* as released by the *thyroid gland* and the *parathyroid hormone (PTH)* as released by the *parathyroid gland* (**Figure 7** shows the location of the two glands). Explain how these two hormones **regulate** the level of calcium in the blood.

(4 marks)

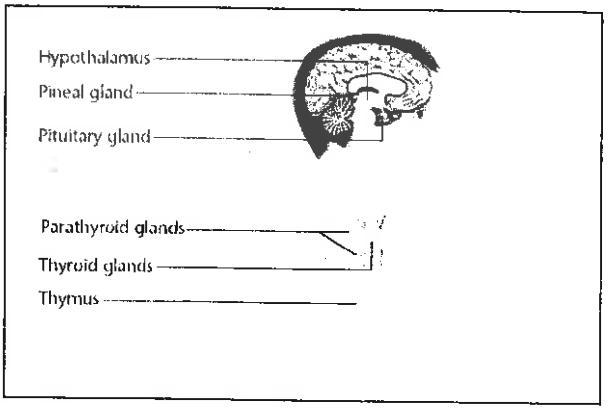

Figure 7

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Question 6 (10 marks)

a. There are two types of hormones, namely *steroid* hormones and *peptide* hormones. Based on this information, answer the following:

(i) What are hormones and how are they important to our bodies? (2 marks)

(ii) In what way do *steroid* hormones and *peptide* hormones differ markedly in their *mechanisms of action*? Explain briefly. (2 marks)

b. Name the two main functions of the process of *transpiration* in land-based plants. For each function, explain how the process helps these land-based plants. (2 marks)

c. A farmer has access to the following four plant hormones: *auxin*, *gibberellins*, *cytokinins* and *ethylene*. In what way could the farmer use each of the four mentioned plant hormones in his production of various types of crops? Explain briefly.

(2 marks)

d. Stimulants affect the central nervous system of an individual that uses them.

(i) Explain the effects that stimulants have on such an individual. (1 mark)

(ii) Large quantities of stimulants can "over-stimulate" the user. Provide some of the symptoms of this over-stimulation. (½ mark)

(iii) What are *hallucinogenic drugs*? (½ mark)

End of Paper